Dealing Issues of Mobile Cloud Computing using 5G Technology

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Abstract
Mobile Cloud Computing (MCC) has become an indispensable part of our daily life. Connectivity between human-to-human, human-to-device and device-to-device is playing a vital role in almost everyone's life round the clock. In MCC, wireless connections are used for the sake of communication which got a bit enhanced in 3G technologies. It resulted in the use of wireless voice telephone, internet access and mobile TV. However, after the arrival of 4G technologies, services like mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, and 3D television has become an unbelievable reality. Still there are several issues faced by MCC applications such as: bandwidth, heterogeneity, availability, power consumption and complicated hardware. In this paper, a brief overview of the issues existing in MCC applications is presented. Further, it is discussed how these issues will be addressed by using 5G technology

Key words:
Mobile Cloud Computing (MCC), Wireless Networks, 4G, 5G, Bandwidth, Heterogeneity.

1. Introduction

MCC is the combination of cloud and mobile with wireless networks to provide the resources of computations for mobile users. MCC is the technology which provides the facility of data storage and processing outside of the mobile devices. It is the technique of virtualization and comprises of different groups of distributed computers instead of local servers. MCC technology is used for the transmission between human-to-human, human-to- device, device-to-device. It enables the user to communicate and exchange information without a single location. In cloud computing information exchanges through wireless connections. This wireless availability provides the organizations to establish their offices in any part of the world.

1G Technology

The first generation was firstly introduced in late 1970's and early in 1980's. In this technology, the facility of voice calls was introduced in a limited distance. These were very small systems and sent information in the form of analog signals. Although many systems were present but the most useful systems that were working at that time were NMT (Nordic Mobile Telephone) and AMPS (Advance Mobile Phone System). The first cellular network was implemented in Japan. Later this technology was adopted by many other countries. Although 1G had many advantages at that time but there are some disadvantages also present in this network generation e.g. quality of voice, roaming, bandwidth and limited area access [1][2].

2G Technology

The 2G mobile networks were introduced in 1990's. GSM was firstly introduced in the 2G. This GSM was named as Group Special Mobiles, which was later changed in to Global system for mobile communication. Text messages were introduced in this generation. In this generation TDMA and CDMA were also introduced for the mobile computing. Digital signals for voice were used instead of analog signals. The problem of international roaming was also present in the first generation which was overcome in this generation. Some issues were also present in the 2G e.g. as it works on digital signals so if the user had low energy power then it could not reach at the cell tower [1][2].

3G Technology

This generation started work in early 2000. In this technique, higher bandwidth was used which reduced the problem of signal clarity to some extent. The transfer of data from one place to another was through packet switching. In this technology the wireless voice telephone, internet access and mobile TV etc. were combined in mobile device. Due to the wide band voice channel, 3G makes the entire world as a village, one man can communicate with other without considering the location. The power consumption is the main issue of the 3G. The other issues that are present in the 3G are poor data rate and propagation delay due to the use of the CDMA [1] [2].

4G Technology

This is the technology which is used now a day's. It started in 2010. This technology is almost 10 times faster than the 3G. LTE is the main innovation of this technology. LTE is used for the data transmission over the IP. It uses OFDM technique which provides the facility of high data rate transfer. In OFDM, the channel is divided into many small

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channels which reduce the interference of the signals. Frequency and time are used for high speed and good reliability. Different services like mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, and 3D television are provided by the 4G. The problems that are present in the 4G are bandwidth, availability and heterogeneity etc. [1] [3].

5G Technology

5G is new and upcoming technology which is based on the IEEE 802.11ac standard of wireless broadband technology, but the formal standard for 5G is yet not set. The 5G is the most advanced and powerful network technology. 5G will provide high data rate speed, high bandwidth, high throughput and support packet switching. The 5G technique will have the vision of RWN (Real Wireless Network), and it will have the capability to support the WWWW. The evaluation and revolutions are the two visions of 5G. In these visions, support for DAWN (Dynamic Adhoc Wireless Network) and interconnectivity for the entire world will be present [4].

In MCC there are a lot of facilities provided by the service providers but still there are different problems like bandwidth, heterogeneity and availability etc. In previous generations of mobile cloud computing the bandwidth was low. With the increase of number of mobile users, the bandwidth is considered as major problem. Heterogeneity is another major issue of MCC. The heterogeneity may be of hardware, software or architecture level. Devices that have different hardware, software or have different architecture may not communicate with each other. The increase in utilization of the resources creates the problem of availability in MCC. In this paper, different problems like bandwidth, heterogeneity and availability of MCC are discussed and later a solution for these problems is proposed based on 5G technology.

The rest of this paper is organized as follows: in Section 2, related work is presented. Mobile Cloud Computing issues are discussed in Section 3. Proposed Solution is presented in Section 4, and finally this research paper is concluded in Section 5.

2. Related Work

Khaleel Ahmad et al. [5] discussed different generations of mobile cloud computing. In first generation of mobile networks, the only facility of voice calls through analogue networks was present. This technology was replaced with frequency bands in the second generation. In the third generation, the technology of wireless voice telephone, internet access and mobile TV were combined in mobile devices. The services like mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, and 3D television are present in the fourth generation. But due to the low bandwidth, the problem of congestion is present. This problem of congestion can be solved with the help of different servers.

Kusuma Kumari B.M [6] discussed the challenges and issues of the mobile cloud computing. Mobile computing is very important in today's world, as the transfer of data from one device to another device with the help of WiFi/Bluetooth is very easy. Organizations can get benefit of mobile computing by integrating their information system. But it has some limitations, e.g. without any physical location of nodes, it is very important for the Mobile Computing to have the network connectivity with the internet.

Pragya Gupta and Sudha Gupta [7] presented an overview of architecture, benefits and key challenges in Mobile Cloud Computing. The simple devices were changed into mobile devices few years ago that provided the facility of voice calls, later these mobile devices were changed into smart devices. These devices overcame the problems like performance, reliability, scalability and heterogeneity to some extent with the help of integration of cloud with mobile environment.

S M Shamim et al. [8] discussed the issues of mobile cloud computing. As the data and computing models are processed in the cloud so there is no need for the powerful configuration in the mobile devices. Different resources like storage and bandwidth has effect on the quality of services, so the main responsibility of the organization is to facilitate the user by providing the smooth services, instead of considering the limitations of the devices. The authors provided the review on cloud computing, it's different definitions and objectives.

Anureet Kaur [9] discussed the problem of low bandwidth, battery consumption, low data rate in earlier generations. Later these problems were solved in MCC with the help of big data but are still present in mobile cloud computing. For this purpose, special processing is required because with traditional techniques these problems cannot be solved. This special processing can be handled through big data with cloud in mobile computations.

Sapana Singh and Pratap Singh [10] discussed about 5G and its architecture. 5G stands for fifth generation technology which will be launched in 2020. The aim of 5G is to reduce the battery consumption, high availability of bandwidth and reduce the latency as compared to the LTE. 5G development is made on the WWWW, Adhoc and Real Wireless World. In 5G, the user can be connected with multiple wireless technologies. As the number of users increases, they can be facilitated with the support of IPv6. Many services can be provided by 5G technology such as: documentation, faster download speed, greater bandwidth

and support to run complicated mobile internet applications.

S Shorgin et al. [11] presented the concept of HetNets 5G technology is the modified version of 4G. It enables different devices to push up over the VOIP. With the passage of time, mobile users are increasing and the demand for different mobile services in a single package is also increasing. So, the goal of the 5G is to provide such kind of facilities like high bandwidth, quick response providing supervision tools and support for virtual private network. For these facilities, hardware like UWB network, smart antennas, Adaptive Array Antennas and software like wireless technologies packet layer is also required [10].

In mobile cloud computing, the problem of energy efficiency and heterogeneity is also present. Although progress has already been made but additional effort is required to improve heterogeneity problem, so that it may satisfy the MCC requirement. Another aspect of 5G is that it is not a solution of all the problems. For this purpose, HetNets technology is introduced for the better performance of the networking which may improve the 5G technology.

The problems that are present in 4G are identified and attempts are made to solve them in 5G for its best performance. In 5G technology, the solution of the problems for bad coverage, interconnectivity and quality of services is considered in its architecture [12]. If the versatile solution is present in 5G then it may provide better performance and satisfy the customers with its services. If we use the previous technology 'RAN' and compare it with the emerging system-level techniques for finding that how they match each other. This will provide us a better solution for the performance of the problem that are present in MCC [13].

3. Issues in Mobile Cloud Computing (MCC)

Following issues are faced by MCC applications:

- Availability
- Bandwidth
- Heterogeneity

3.1 Availability

Availability can be defined as whether something that we want to use is available or not. In MCC the availability is defined as to access the channel when it is required for the communication. The access failure of the network by the user is known as the unavailability. When we consider the MCC, there is no guarantee to access the network. Major features of availability are response time, cost, utilization, error rate, and network accuracy. If the response time will be decreased then it might increase the cost.

The network accuracy worsens by the radio interference. Due to this the throughput is also affected and remains low. So, it is the responsibility of the network management to compensate these factors. The mobiles did not have the high accuracy as compared to non-mobile devices. When the accuracy is disturbed the throughput is also affected. In recent years, some technologies were introduced which provide low error rate, network accuracy for the users. The demand of the Radio channels is too high but the accuracy is also suffered by the radio meddling. Due to this radio meddling, availability of the channel is disturbed. Another problem due to which availability is affected, is the utilization. Therefore, the availability is the main problem that is faced by the users.

3.2 Bandwidth

When signals from different resources travel in parallel at high speed, it is known as bandwidth. Bandwidth is the main problem of mobile communications. When the bandwidth is low the speed of the signals automatically decreases. But if we compress our data before sending on the channel, its utilization can be improved. The bandwidth utilization relay on the data that has been sent on the medium. If large data is transferred on the medium then it surely increases the latency and decreases the efficiency. The bandwidth problem is still present in 3G and 4G.

The bandwidth of the wireless networks is lesser than the wired systems, as the capacity of the network depends on users of the network, and this capacity is measured by the bandwidth per cubic meter. So, the number of mobile users increases with time and they want to use more applications on their mobile. It affects the performance as the available bandwidth is not enough that can be used for these services. In previous generations of the network, lower bandwidth was available due to which the user was not facilitated by the services that were provided. Although in previous generations this problem was solved but still exists at some level [14].

3.3 Heterogeneity

In mobile communication, combination of different cells and access technologies work together known as heterogeneity. While HetNets (Heterogeneous Network) can be defined as when computers and different devices that have different protocols and operating system are combined with each other for resource sharing. There are different types of heterogeneity such as:

a. Hardware Heterogeneity

The different devices and different network technologies combined with each other is known as hardware heterogeneity [15].

b. Software Heterogeneity

When different operating systems and application programs are combined, it is known as software heterogeneity [15].

c. Architectural Heterogeneity

When different network interconnection does not exchange their common architectural properties.

Presence of distinctive hardware, architectures, infrastructure, technologies of mobile devices, clouds, and wireless networks may form Heterogeneity in MCC. Heterogeneous computing devices toward unrestricted mobile computing are expecting the cutting-edge technologies to initiate and facilitate collaboration among them [15].

d. Heterogeneity in Mobile Devices

Different variations of hardware, software and technology between the communication devices is the reason of this domain. The frequent increase of smart phones, different dimensions like brand, hardware, operating system create dynamic and demanding market. This collaboration is more challenging in MCC [16].

e. Heterogeneity in Clouds

Due to the diverse custom build policies, and APIs the cloud becomes heterogeneous. In cloud computing due to the variations the interoperability and portability are the major challenges. There is an idea that business competition also differentiates cloud providers with their heterogeneous frameworks, exacerbating heterogeneity on the cloud side [16].

f. Heterogeneity in Wireless Networks

In mobile networks, the communication takes place in wireless networks, which is a heterogeneous communication medium. Differences in wireless networks and their related technologies impact the delivery of cloud services and affect mobility, augmentation, and usability of smartphones [16].

4. Proposed Solution

For bandwidth, we can use different protocols like:

4.1 6LoWPAN

6LoWPAN is known as IPv6 over Low-Power Wireless Personal Area Networks. The connection between physical and real-world applications is required to work together. Wireless network involves the devices that have low power and cost. The problem that exists in it due to the low bandwidth is the frame of 802.15.4, which may not fit in it because of IPv6 (40 octets), TCP (20 octets), UDP (8 octets) + other layers leaving few bytes for data [17].

4.2 Bluetooth V4.0

The Bluetooth protocol RFCOMM is a transport protocol, which is based on L2CAP protocol. Blue tooth is used to exchange the data between devices within a limited area. It is alternative of the RS-232 data cables. Blue tooth cannot be used for large data because the transfer rate is very slow due to low bandwidth [18].

4.3 ZigBee

ZigBee is low power and low data rate wireless system for very short distance. Its range is very limited so it can be used only for the PAN (Personal Area Network). It cannot be used for the outdoor, due to the low date rate. It uses low bandwidth which is not good for large data [19].

4.4 Sigfox

It is a protocol used for wide-range. It lies between the cellular and WiFi. It was designed for the communications between mobiles and it requires very low battery consumption. It can be used for very low data rate. With the help of this protocol 10 to 1000 bits can be sent over the medium in a second. UNB (Ultra Narrow Band) technology is used in it. Therefore, this protocol can only be used for the short distance and for very low data rate but as the number of users increases day to day, and their requirements are changed, so it is need of the hour that use such type of protocols from which communication can take place regardless of considering the distance [20].

4.5 Dynamic Hash Table (DHT)

Above mentioned protocols can be used to solve the problem of bandwidth in limited area networks like PAN. There are too many other protocols that are used for WAN (Wide Area Network) to solve the problem of bandwidth. In our proposal, this problem can be solved using DHT (Dynamic Hash table) for WAN. It is decentralized distributed system like hash table. A pair of key and value are stored in the DHT. A map between the keys and values can be maintained by the nodes. When a node is changed then very little disturbance is created. As the hash table buckets are the independent nodes of a network so when a key is required to find the hash table then hashing is applied on it.

4.6 Tree Like Structure

Heterogeneity is another problem of the mobile cloud computing, heterogeneities can be off hardware, software or architecture base. Different devices with respect to these types has different brands, architecture and operating system etc. Due to this these devices cannot share the information with each other.

Availability is also a major issue which is present in the mobile cloud computing. Availability has different features like response time, cost, utilization, accuracy and low error rate. These are the services that can be very important for the better performance of the availability.

The proposed solution for the heterogeneity and availability problem is Tree Like Structure. Because it is very simple and efficient routing protocol. It allows the user to be self-organized and configuring. This protocol follows on-demand method. When a node requires to connect with the internet and want to transmit the data over the link then firstly it request to connect and after that it will send the data. This method reduces the traffic on the link because the medium will remain free when the nodes did not want to transmit the data. With this method, the availability and heterogeneity problem can be solved to some extent.

5. Conclusion and Future Work

Mobile communication is breath taking technology to access the internet and for daily communication. As in future the users will be dependent on the mobiles so a modern technology will be required that can be easy to use for the end users. In this paper, we have discussed different issues that are present in Mobile Cloud Computing (MCC) and in different technologies of network generations. Several issues may be present but here we have discussed about the bandwidth, heterogeneity and availability. We proposed a solution based on Dynamic Hash Table (DHT) for the bandwidth, and Tree Like Structure for the availability and heterogeneity. In future, we want to further explore the 5G technology and its impact on communication.

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